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THE MOLLUSCA OF THE MT. MITCHELL REGION, NORTH CAROLINA.

BY BRYANT WALKER AND HENRY A. PILSBRY.

This report is based upon material collected by Messrs. James H. Ferriss and Bryant Walker in the summer of 1901.

The results of the "Pentadelphian" expedition of 1899 to the Great Smoky mountains¹ demonstrated the fact that these mountains, notably in their higher portions, possessed a fauna peculiar to themselves and quite distinct from that of Roan Mountain which lies about seventy-five miles to the northeast. And in connection with this, it was stated that "the mountain region between the Nolachucky and Clingman's Dome is wholly unknown malacologically."

The expedition of 1901 was undertaken primarily for the purpose of exploring Mt. Mitchell, the highest peak of the Appalachian range, with an altitude of 6,711 feet, of whose fauna nothing was known except a few species collected by Hemphill in a hurried visit nearly twenty years before, and incidentally to determine, if possible, whether the valley of the French Broad river, which here breaks through the mountains, is the dividing line between the Roan and Great Smoky faunas.

The party consisted of Messrs. Ferriss and Walker and two ladies. Leaving the railroad at Paint Rock, N. C., a little station on the French Broad river just over the line from Tennessee, altitude about 1,200 feet, two days were spent in exploring the banks on both sides of the river.

From there the route lay almost due south for ten mountain miles to Bluff mountain, which is the highest of the range lying south of the river for a considerable distance. It took the wretched crowbars which hauled the camp equipage in a wagon that weighed more than the load, all hands pushing up the steep grades, nearly all day to reach Baker's, an old lumber camp, which marked the end of wagon travel. Here camp was made, and the next morn-

¹ *Vide these Proceedings*, 1900, p. 110.

ing the party "toted" themselves and their luggage to the summit. Bluff mountain derives its name from the long, narrow plateau nearly three-quarters of a mile in length which forms its top, the highest point of which is about 4,700 feet above the sea. The State line between Tennessee and North Carolina crosses its western extremity. The forest here is entirely of hard wood, and the greater part of the plateau is covered by high trees. Most of the underbrush has been cleared off from the summit, which is frequently used for camp meetings and other public gatherings. Most of the collecting here was done along the sides of the cove on the Tennessee side, where Wolf creek heads. The southern exposures, as usual, were too dry for satisfactory work.

Three days were sufficient to satisfy the party that the fauna was substantially that of the cove region, and that the mountain was too low for the development of any special fauna, such as had been found on the higher summits both to the north and the south. And, as the mountains immediately north of the river offered no better prospect, it was decided to return to Paint Rock and proceed directly to Mt. Mitchell.

From Black Mountain station on the Southern Railroad, the journey was made by wagon to Tyson's, an ancient inn at the foot of the Black Mountain range. Here the baggage was loaded on horses for the ten-mile climb to the summit of Mt. Mitchell. The road followed up the course of one of the branches of the North Fork of the Swannanoa river to its headwaters, from which a sharp ascent leads to the top of the ridge at Patton's Knob, at an elevation of 6,000 feet. From there the trail leads nearly due north around Potato Top, directly over Clingman's Peak (Mt. Gibbs on the map of the Topographical Survey), which is only a few feet lower than Mitchell, and where Ferriss "drew the first blood" by finding the long-sought *Vitrea clingmani* under a log beside the trail, and then winding around the Hallbach, and across Wilson's Gap on up to Mitchell. Here the summit is a small "bald," in the centre of which is the grave and monument of Prof. Elisha Mitchell, who lost his life while exploring this mountain in 1857. Camp was pitched just beyond the summit, at the head of a grassy slope and near a fine spring of the purest water. The forest extends clear to the top of Mitchell, and in some places the tops of trees have been cut off to allow a view from the

“bald” which crowns the summit. It is almost wholly spruce and balsam, a few birches being found here and there. Open places are quite frequent, and are often covered with a dense growth of the hellebore, the favorite food of *Polygyra andrewsae*. The ground is saturated with moisture and the rocks and fallen trees are covered with thick moss, which needs only to be sat upon to remind one of a sponge.

Two days were spent exploring the upper slopes of the mountain. Then Ferriss, with one of the guides, left on a three days' trip, following the Black Mountain chain to the north, along which five great peaks were to be seen ranging from 6,300 to 6,600 feet, and which seemed from the camp to be higher even than Mitchell itself. Following bear tracks along the ridge, he went as far north as the fourth peak (Cattail), from which he descended along Cattail branch to the Caney river, and thence up through Wilson's Cove to Mitchell, stopping for a short time at Meadow Cove. Two days were spent by the party in Wilson's Cove, which is heavily timbered with great basswoods and buckeyes, and most of the material was collected there. An attempt to follow down the northeast slope of the mountain along the headwaters of Rock creek, a tributary of the Toe river, was blocked by a high fall in the creek and was also conchologically a failure.

After spending a week on Mitchell, the party returned to Patton's Knob. Here Walker left to return home, and Ferriss continued the work alone. He explored Potato Top (6,600 feet), and crossing the gap which separates the headwaters of the Swannanoa river from those of the Toe, ascended the Pinnacle of the Blue ridge (alt. 5,600 feet), reaching the headwaters of the South Toe river on its easterly slope.

Returning again to Patton's Knob, he followed along the ridge to the west, camping at Balsam Gap, between the Ivy and Swannanoa rivers (alt. 5,000 feet). “Here the spruce forest ceases and the buckeyes and beeches set in.” From this camp he went down the west slope of the gap to the Ivy river. Leaving the gap, he continued south along the ridge of the Great Craggy mountains as far as Big Craggy, where he camped until he was literally drowned out by the great storm of August 12 to 19. It rained almost continually while on Craggy, so that but little collecting was done. But he got down into Bee Tree Cove on the west side while

there. "Timber was scarce on the tops of the Craggies. There was much pasture, and some of the red rhododendron. Wide 'balds,' but exceedingly rocky, the most mountainlike of anything I have seen" (J. H. F.). After the return from Craggy, the remainder of the time was spent in exploring Tyson's Cove.

THE FAUNA.

So far as the material before us affords a basis of judgment, it goes to show:

First.—That the French Broad river is not in itself the dividing line between the Roan and Smoky faunas.

Second.—That in all probability there is no sharp line of demarcation anywhere. But that in the intermediate region lying between these faunal centres, the species peculiar to each mingle to a greater or less extent, according as they find acceptable conditions of environment.

Third.—That in the French Broad river region there are a number of peculiar forms which tend to show that it has, at least, some of the characteristics of a distinct faunal area.

Thus, in the species which inhabit the lower levels between the mountains, and which may be considered as the cove fauna, we find that the great majority are species common in the Appalachian range along its whole extent. Occasionally, however, in these, such as *Polygyra tridentata* and *Pyramidula alternata*, local races are developed, which are eminently characteristic of the different regions.

In addition to these species of general occurrence, we find others which are apparently restricted to narrower limits and which, with the local races above mentioned, give these areas the peculiar features, which taken in connection with the still more differentiated elements occupying the higher levels, justify their separation as distinct faunas, or rather faunulas.

Taking the whole region from Roan to the Great Smoky mountains into consideration, however, we find that so far as the cove species are concerned, the differences are not so great as they appear at first sight, and that in reality they are comparatively small though sufficiently well marked. The only species peculiar to the coves around Roan are the large and small forms of *Polygyra tridentata*, *Pyramidula bryanti*, *Polygyra subpalliata* and *Omph-*

lina rugeli. Of these, the first three are found as far south, at least, as the French Broad, and the last two are offshoots from the summit fauna slightly modified by more favorable conditions of environment. In the same way, of the species inhabiting the coves of the Smoky mountains, only *Polygyra christyi*, *P. depilata*,² *Pyramidula alternata costata*, *Omphalina fuliginosa polita*, *Omphalina levigata latior* and *perlaevis*, *Zonitoides patuloides* and *Punctum blandianum* have not as yet been found to range far enough to the north to mingle with the southern extension of the Roan species. *Polygyra chilhoweensis*, *P. pilula*, *P. monodon cincta* and *Strobilops labyrinthica strebli* extend at least as far north as the French Broad river, and some of them much further.³

Thus we find a large proportion of what were supposed to be the characteristic cove species of these two regions mingled together in the valley of the French Broad.

On the other hand, just as there are some species peculiar to each of these regions, so we find in the coves tributary to the French Broad drainage a few characteristic forms, which seem to be (without exception) lacking in the coves both to the north and the south.

From Bluff mountain to Mitchell, throughout this region, there appears a peculiar form of *Polygyra andrewsae*, which is intermediate in size and shape between the typical *andrewsae* of Roan and Mitchell, and the larger variety *normalis*, which inhabits the coves from Roan to the Little Tennessee river, and is decidedly characteristic of the French Broad region. It extends, however, north into the lower coves of the Roan region.

The beautiful and long-lost *Pyramidula alternata mordax* is apparently restricted to a small portion of this area.

The almost total absence of typical *Gastroponta gularis*, so abundant in Roan and in the Smoky mountains, and its replacement by two peculiar forms, var. *theloides* A. D. Brown and var. *decussata* P. and V., is also another striking feature of this region. Again, we find in the French Broad valley a number of species, mostly common and widespread, which are found in the Roan region, but

² The "P. depilata" collected at Johnson City, Tenn., by Rhoads (*P. A. N. S. P.*, 1896, p. 493) is *P. stenotrema nuda*. (*Vide* these *Proceedings*, 1900, p. 129.)

³ *P. chilhoweensis*, Campbell Co., Tenn. (Wetherby), and Carysville, Campbell Co., Tenn. (Walker and Clapp coll.).

which seem to be missing in the coves of the Smoky mountains. Such are :

<i>Polygyra inflecta.</i>	<i>Polygyra clausa.</i>
<i>Polygyra sayii.</i>	<i>Vitre a hammonis.</i>
<i>Polygyra altispira.</i>	<i>Omphalina fuliginosa.</i>
<i>Polygyra profunda.</i>	

Several of these species have a range along the Cumberland plateau considerably further south. But the assiduous collecting of Ferriss and others during several years has wholly failed to discover them in the coves of the Great Smoky range. Whether the valley of the French Broad is practically the southern limit of the range of these species along the main chain of the Appalachians is not known, as the region south of Bluff mountain is as yet wholly unexplored. But, from the comparatively few specimens found in 1901, it would seem to be a fair inference that such was the case.

Taking all these factors into consideration, we would say that as a whole, the cove fauna of the French Broad valley is more closely related to that of the Roan region than to that of the Great Smoky mountains.

The same general fact appears also when the fauna of the higher elevations is considered.

The characteristic species of the Roan summit fauna are :

<i>Polygyra andrewsae</i> (typical).	<i>Gastrodonta capsella placentula.</i>
<i>Polygyra wheatleyi.</i>	<i>Gastrodonta gularis.</i>
<i>Polygyra subpalliat a.</i>	<i>Gastrodonta acerra.</i>
<i>Polygyra altispira.</i>	<i>Gastrodonta andrewsae.</i>
<i>Omphalina rugeli.</i>	<i>Gastrodonta caelaxis.</i>
<i>Omphalina subplana.</i>	<i>Gastrodonta lamellidens.</i>
<i>Vitrinizonites latissimus.</i>	<i>Philomycus wetherbyi.</i>
<i>Vitre a sculptilis.</i>	<i>Philomycus hemphilli.</i>
<i>Vitre a carolinensis.</i>	<i>Succinea ovalis.</i>
<i>Gastrodonta capsella.</i>	

Of these,

<i>Polygyra wheatleyi.</i>	<i>Vitre a carolinensis.</i>
<i>Omphalina subplana.</i>	<i>Gastrodonta gularis</i> (in its various forms).
<i>Vitrinizonites latissimus.</i>	
<i>Vitre a sculptilis.</i>	<i>Gastrodonta acerra.</i>

Gastrodonta capsella. *Philomycus hemphillii.*

Gastrodonta capsella placentula. *Succinea ovalis,*

Gastrodonta lamellidens.

are all found on the summits of the Smoky mountains and nearly all of them on Mitchell or Bluff mountain.

Of the remainder, *Polygyra andrewsæ* is the characteristic species of Mt. Mitchell, and *Polygyra altispira* and *Gastrodonta andrewsæ* were found generally distributed in the French Broad region, so that *Polygyra subpalliata*, *Omphalina rugeli*, *Gastrodonta caelaris* and *Philomycus wetherbyi* are really the only species peculiar to the Roan summit.

Upon the higher levels of the Smoky mountains, on the other hand, we find a larger number of peculiar species which do not seem to extend so far north as the French Broad. These are:

Polygyra ferrissii. *Omphalina andrewsæ montivaga.*

Polygyra clarkii. *Vitrinizonites lasitismus.*

Vitreæ petrophila. *Vitrinizonites uvidermis.*

Vitreæ pentadelphia.

The apparent poverty of the higher peaks of the French Broad region in peculiar species was both a surprise and a disappointment. The probability that Mt. Mitchell, the giant of them all, would at least furnish a rival to the beautiful *Polygyra ferrissii* seemed so great, that the failure to find one was scarcely compensated by the rediscovery of the rare little *Vitreæ clingmani* Dall. This seems to be the only species peculiar to Mt. Mitchell, and the expedition felt like engraving on its highest pinnacle the old proverb: “*montes parturiunt, nascitur ridiculus mus.*”

The following list of all the species known from the mountain region lying between Roan mountain and the Little Tennessee river will show the general range of each species in the three districts that have been explored, upon which the foregoing remarks have been based:

COMPARATIVE LIST.

R. = Roan ; F. = French Broad ; S. = Smoky.

	R	F	S		R	F	S
<i>Helicina</i> ⁴ <i>occulta</i>	x	x	x	<i>Omphalina fuliginosa polita</i> .			x
<i>Polygyra tridentata</i>	x	x	x	<i>lævigata</i>	x	x	x
<i>tridentata tennesseensis</i>	x	x		<i>lævigata latior</i>		x	
<i>fraudulenta</i>	x	x	x	<i>lævigata perlævis</i>			x
<i>rugeli</i>	x	x	x	<i>rugeli</i>	x		
<i>inflecta</i>	x	x		<i>subplana</i>	x	x	x
<i>profunda</i>	x	x		<i>andrewsæ</i>		x	x
<i>sayii</i>	x	x		<i>andrewsæ montivaga</i>			x
<i>chilhoweensis</i>	x	x		<i>Vitrinizonites latissimus</i>	x	x	
<i>albolabris</i>	x	x	x	<i>latissimus uvidermis</i>		x	
<i>albolabris major</i>	x			<i>Vitreo hammonis</i>	x	x	x
<i>exoleta</i>	x	x	x	<i>wheatleyi</i>	x		
<i>ferrissii</i>		x		<i>clingmani</i>		x	
<i>subpalliata</i>	x			<i>petrophila pentadelphia</i>			x
<i>palliata</i>	x	x	x	<i>indentata</i>		x	
<i>appressa perigrapta</i>	x	x	x	<i>rhoadsi</i>	x		x
<i>clarkii</i>		x		<i>sculptilis</i>	x	x	x
<i>andrewsæ</i>	x	x		<i>carolinensis</i>	x	x	
<i>andrewsæ normalis</i>	x	x	x	<i>carolinensis wetherbyi</i>	x	x	
<i>andrewsæ altivaga</i>		x		<i>ferrea</i>		x ⁵	
<i>andrewsæ intermedia</i>	x	x		<i>approxima</i>		x	
<i>thyroides</i>	x	x	x	<i>vanattai</i>		x	
<i>clausa</i>	x	x	x ⁴	<i>Euconulus sterkei</i>	x		
<i>wheatleyi</i>	x	x	x	<i>fulvus</i> ?.....	x ⁶		
<i>christyi</i>		x		<i>chersinus</i>			x
<i>edwardsi</i>	x			<i>Zonitoides arboreus</i>	x	x	
<i>edwardsi magnifumosa</i>		x		<i>patuloides</i>			x
<i>stenotrema</i>	x	x		<i>minusculus</i>	x		
<i>depilata</i>		x		<i>milium</i>	x		
<i>hirsuta</i>	x			<i>elliottii</i>	x	x	x
<i>pilula</i>	x	x		<i>Gastrodonta intertexta</i>	x		x
<i>altispira</i>	x	x		<i>acerra</i>	x	x	
<i>monodon cincta</i>	x	x		<i>demissa</i>	x	x	x
<i>Strobilops labyrinthica strebeli</i>	x	x		<i>cerinoidea</i> ?.....	x ⁷		
<i>Bifidaria contracta</i>	x	x		<i>ligera</i>	x		
<i>pentodon</i>	x			<i>gularis</i>	x	x	x
<i>Vertigo bollesiana</i>		x		<i>gularis lavae</i>	x		
<i>Cochlicopa lubrica</i>	x	x	x	<i>gularis theloides</i>	x		
<i>Circinaria concava</i>	x	x	x	<i>gularis decussata</i>	x		
<i>Omphalina kopnodes</i>	x?			<i>gularis cuspidata</i>	x		
<i>fuliginosa</i>	x	x		<i>suppressa</i>	x	x	x
				<i>calaxis</i>	x		

⁴ *P. clausa* was not found in Smoky mountains. It occurs, however, at Hayesville, N. C.

⁵ This species also occurs at Lickstone mountain, near Waynesville, N. C.

⁶ Cited by Wetherby. We have seen no specimens, and it is quite probable that the identification is erroneous as the group had not been differentiated when Wetherby's list was published.

⁷ These species were cited by Wetherby in 1881. As they are not included in his later paper (1894), it is probable that he found that his former identification was erroneous.

	R	F	S		R	F	S
<i>Gastroponta interna</i>	x	x	x	<i>Pyramidula alternata</i>		x	x
<i>andrewsae</i>	x	x		<i>alternata fergusoni?</i>	x ⁸		
<i>multidentata</i>	x			<i>alternata costata</i>		x	
<i>lamellidens</i>	x	x	x	<i>alternata mordax</i>		x	
<i>clappi</i>		x		<i>perspectiva</i>		x	x
<i>walkeri</i>		x		<i>bryanti</i>		x	x
<i>significans?</i>	x ⁷			<i>Helicodiscus lineatus</i>		x	x
<i>capsella</i>	x	x		<i>Punctum pygmaeum</i>		x	
<i>capsella placentula</i>	x	x		<i>blandianum</i>		x	
<i>Agriolimax campestris</i>	x			<i>Sphyraedium edentulum</i>		x	
<i>Philomycus carolinensis</i>	x	x	x	<i>Succinea ovalis</i>		x	x
<i>wetherbyi</i>	x	x		<i>Carychium exiguum</i>	x		
<i>hempilli</i>	x	x	x				

LIST OF SPECIES.

HELICINIDÆ.

Helicina occulta Say.

Wilson's Cove, Mt. Mitchell. A few large specimens, diam. $7\frac{1}{4}$ to 8 mm., were found under the dead leaves around the roots of the basswoods and buckeyes ; all were of the uniform deep reddish-yellow color characteristic of the species from other localities. There was no apparent tendency to the great variation in color noted by Wetherby in the Roan mountain specimens.

HELICIDÆ.

Polygyra tridentata (Say).

With the exception of the large variety found at Paint Rock mentioned below, this species, which was found nearly everywhere, shows but slight variation from a common type, which seems decidedly characteristic of the whole region from Roan to the Smoky mountains. It is usually rather small, varying from $12\frac{1}{2}$ to 14 mm. in diameter at Roan to 17 to $18\frac{1}{4}$ at Bluff mountain.

The size seems to increase quite regularly from the north to the south, specimens from Cat-tail (14 to 15) being smaller than those from Wilson's Cove ($13\frac{3}{4}$ to $15\frac{3}{4}$), while these are decidedly smaller than those from Paint Rock and Bluff mountain. This race, for it hardly seems to be sufficiently differentiated to be entitled

⁸ Specimens from Roan before us belong to the smooth form herein-after mentioned, but are not typical *fergusoni*. Wetherby's specimens were probably the same.

to varietal rank, is characterized by closely coiled whorls and usually rather high spire, in this respect showing some approach to *P. fraudulenta*. But the aperture is usually quite typical in the position and shape of the lip teeth. Occasional specimens exhibit a slight tendency to "dishing" of the upper portion of the lip, but in such instances the deepest concavity of the lip is between the labial teeth rather than opposite the upper tooth, as in *fraudulenta*, nor is there any rounding out of the upper lip so characteristic of that species. The shell is usually of a deep reddish horn color, with a rose-tinted lip, and closely and rather heavily striate. Wetherby (*Journ. Cin. Soc. N. H.*, 1894, p. 211) has called attention to this form as peculiar to the Roan region, and the material before us shows that it extends through this whole region with but slight variation except in size. The "buttressed" lower tooth developed in the Smoky mountains⁹ seems peculiar to that region, as no tendency in that direction appears in any of the shells collected in the French Broad drainage. Three of five specimens from Bluff mountain have an unusually heavy wide flat white lip, which sensibly diminishes the aperture. In addition to the localities already mentioned, Ferriss reports it from Tyson's Cove, Meadow Cove, Ivy river, Toe river and Bee Tree creek.

Polygyra tridentata tennesseensis n. v.

At the foot of the high bluffs which line the south side of the French Broad river below Paint Rock, just over the line in Tennessee, there occurred a very distinct form of *P. tridentata*, characterized by its large size, depressed *complanata*-like form, but closely and regularly striated. The lip is that of the typical *tridentata*, with rather small marginal teeth. Of twenty specimens the smallest was 19 and the largest 24 mm. in diam., the average being $22\frac{1}{2}$. Only two were less than 21. This form is probably the same as that mentioned by Wetherby¹⁰ from Braden mountain, Campbell county, Tenn., and is the same described by Clapp¹¹ from Oakdale, Morgan county, and Concord, Knox county, Tenn. It is also the same form found at Elizabethton, Tenn., and erroneously by one of us referred to var. *complanata*.¹² The Elizabethton

⁹ *Vide* these *Proc.*, 1900, p. 117.

¹⁰ *Journ. Cincinnati Soc. N. H.*, 1904, p. 212.

¹¹ These *Proceedings* for 1900, p. 117.

¹² *Nautilus*, XII, 120.

examples are lighter in color than the Paint Rock specimens and rather smaller, being from $19\frac{1}{2}$ to $21\frac{1}{4}$ mm. in diameter, in this respect resembling the Morgan county shells, described by Clapp.

Polygyra fraudulenta Pilsbry.

Meadow Cove, a single typical example, diameter 15 mm.

Polygyra rugeli (Shuttle).

Of general occurrence, but not so abundant as in the Great Smoky mountains. At Paint Rock, south side, where it occurred with *P. tridentata tennesseensis*, the specimens were uniformly large, $13\frac{1}{4}$ to $14\frac{1}{4}$ mm. in diameter. Another lot from the same side, collected later by one of the guides, but probably further down the river, were smaller, 11 to $12\frac{1}{4}$ mm. Similar specimens were found at Paint Rock creek, on the north side of the river. This seems to be the prevailing size throughout the French Broad region, and only occasional specimens from Bluff mountain, Tyson's Cove and Wilson's Cove exceeded 13 mm. in diameter. Ferriss found a few specimens also at Meadow Cove, Ivy river, Toe river and Bee Tree creek.

Polygyra inflecta (Say).

At Paint Rock, on the south side of the river, all the specimens were small, 9 to $9\frac{1}{4}$ mm. in diameter, with the whole shell more or less tinged with pink and frequently the lip as well.

In the coves around Mitchell, Cat-tail, Tyson's and Wilson's, all the specimens were albinos and quite large, $13\frac{1}{2}$ to 14 mm. in diameter. Not a single normally colored individual was found in any of these localities. While occasional albino examples are not uncommon in nearly all the American Helicidae, this occurrence of a race wholly albino inhabiting a large extent of territory is quite without precedent. Why this one species should be affected in this way is difficult to understand. None of the other species in the district exhibited any tendency to albinism to any greater extent than is likely to occur anywhere. It forms one of the striking peculiarities of the Mitchell fauna, and is analogous to the occurrence of *Polygyra subpalliatata* at Roan, which is always of the same pale-green color.

Polygyra profunda (Say).

Paint Rock, south side, two specimens only; evidently scarce.

Polygyra sayii (Binn.).

Paint Rock, south side, and Wilson's Cove, a few specimens with no special characteristics.

Polygyra chilhoweensis (Lewis).

Paint Rock creek, on the north side of the river. Two specimens only. This extends the range of this species considerably farther north than has hitherto been recorded.¹³

Along the Cumberland plateau it has, however, a range considerably farther north, having been found in Campbell county by Wetherby.¹⁴ Similar specimens are now in the collections of G. H. Clapp and Bryant Walker. It seems probable that the French Broad valley is about the northern limit of the range of this species along the Appalachians.

Polygyra albolabris (Say).

This species occurred only at Paint Rock, on the north side of the river, where it is apparently quite abundant. All the specimens are more or less deeply tinged with rose and one is obscurely banded below the suture. They are very similar to the Cade's Cove examples mentioned in the report on the "Pentadelphian" expedition.

Polygyra exoleta (Binn.).

Paint Rock, south side, two specimens. Cat-tail branch, one example.

Polygyra palliata (Say).

Paint Rock, south side, four specimens, 22 to 24 mm. in diameter; quite typical.

Polygyra appressa perigrapta Pilsbry.

Paint Rock, on both sides of the river, Bluff mountain and Wilson's Cove. Noticeably smaller and more compressed than those from the Smoky mountains. Of fifteen specimens from these localities, the smallest was $15\frac{1}{2}$ mm. in diameter, the largest $17\frac{1}{2}$, average $16\frac{1}{2}$ mm., while those from the Smoky region range

¹³ In the J. H. Thompson collection, now in the possession of one of us, are two specimens labeled "Roan Mt. ex auctore." As the species is not cited by Wetherby from Roan and there are no specimens from that locality in the Lewis collection, now owned by Mr. G. H. Clapp, it seems probable that there is some mistake in regard to the Thompson shells.

¹⁴ *Jour. C. S. N. H.*, 1894, p. 212.

from 19 to $21\frac{1}{2}$ mm. and are in every way larger and finer specimens.

Polygyra andrewsæ (W. G. Binn.).

The typical form of this fine species was quite abundant all along the ridge from Clingman Peak to Mt. Mitchell. It is partial to the hellebore (*Veratrum viride*) which grows rankly in the open spaces, and was usually found either roosting beneath the large leaves or hidden in the grass around the roots. The shells are exceedingly fragile and were often crushed between the fingers in the slight pressure occasioned by lifting them from their hiding-places. They are uniformly of a dark olive-green color, with a thin, narrow, concave lip. Of sixty-five specimens the largest was $27\frac{1}{4}$ mm. in diameter, the smallest $22\frac{1}{2}$, average $24\frac{9}{10}$. Compared with Roan mountain specimens they differ only in size, being on the average slightly larger. Of thirty-nine Roan specimens the smallest was 19, the largest $22\frac{1}{2}$. The shells from both localities are alike in the extreme fragility, narrow lip and shape. And in both places this form is found only on the highest parts of the mountain.

Polygyra andrewsæ normalis Pilsbry.

This form is purely a cove dweller and is rarely found at an elevation of more than 5,000 feet. From 1,200 to 4,000 is about its usual range. It occurred sparingly on both sides of the river at Paint Rock (alt. 1,200 feet), and on Bluff mountain as far up as Baker's (alt. 3,000 feet). These specimens were of the usual type and varied from $35\frac{1}{2}$ to $37\frac{1}{2}$ in diameter.

It also occurred at Tyson's Cove (alt. 4,000 feet), Meadow Cove and Wilson's Cove (alt. 3,500 feet). Those from Wilson's were the largest yet seen. Of thirty-seven specimens, the largest was $40\frac{1}{2}$ mm. in diameter, the smallest 34, average $37\frac{1}{4}$. They vary considerably in shape, frequently becoming subconical as shown by the following measurements: $37\frac{1}{2} \times 32$, $41\frac{1}{4} \times 35\frac{1}{4}$, $39\frac{1}{2} \times 35$ and $38\frac{1}{4} \times 28\frac{1}{4}$. Occasional pale-green albinos occurred.

Polygyra andrewsæ intermedia n. subsp.

Throughout this region, occupying the higher levels from 3,500 to 5,000 feet, and thus ranging above the var. *normalis*, but below the typical *andrewsæ*, was found a well-marked race which cannot be satisfactorily assigned to any of the recognized varieties. It is

intermediate between the typical form characteristic of the higher altitudes of Roan and Mitchell and subsp. *altivaga*, which similarly occupies the summits of the Smoky mountains. In texture, sculpture, color and character of the peristome it is nearer to *altivaga*, but in shape is more like the typical *andrewsae*. On the whole, however, it is more nearly related to the former. It may be characterized as typical in shape, but larger, with a stronger, thicker shell, closely and regularly striate, lighter in color being usually with a strong yellowish tinge, frequently pale green, and occasionally tinged with red; the lip is decidedly different from the typical *andrewsae*, being broader and flatly reflected; in many cases the reflected portion is decidedly convex, being rolled back so that the center of the face of the peristome projects beyond the outer edge. Compared with var. *altivaga* it is decidedly less globose, being wider in proportion to its height. The aperture also is proportionately wider than in *altivaga*.

It was first met with on Bluff mountain at Baker's, and ranged from there to the summit. Of eight specimens, the largest was $30\frac{1}{2}$ mm. in diameter, the smallest $26\frac{1}{2}$, average $28\frac{3}{4}$ mm. The largest example compared with a Thunderhead specimen of the same diameter, $30\frac{1}{2}$ mm., will show the following difference in height and breadth which is characteristic of the race:

	Diam.	Total Alt.	Alt. of Axis.
Bluff mountain (<i>intermedia</i>), . . .	$30\frac{1}{2}$	22	$15\frac{1}{2}$
Thunderhead (<i>altivaga</i>), . . .	$30\frac{1}{2}$	22	$16\frac{1}{2}$

Potato Top (4,000 feet), six specimens, largest $30 \times 20\frac{1}{4}$, smallest $26\frac{1}{4} \times 20$, average $28\frac{1}{2}$ mm.

Vance's branch, North fork of the Swannanoa river, two specimens, rather heavier than usual, 26×20 and $26\frac{1}{4} \times 20$ mm.

Bee Tree creek, Craggy mountains (alt. 3,500 feet), three specimens similar to those from Vance's branch. Shells as thick as those of subsp. *normalis*. These specimens are very close to subsp. *altivaga*, and have the notch at the upper end of the peristome as in that form. They measure 25, 27 and $27\frac{1}{4}$ mm. in diameter. One of them is decidedly reddish horn-colored. On Craggy, Ferriss found *intermedia* all along from 4,500 to 6,000 feet. He remarks that its habits are similar to those of *Polygyra exoleta* and solitary.

Two specimens from Balsam Gap, Ivy river (alt. 3,500 feet),

are more nearly allied to the typical form, both in texture and the width of the peristome. But in one example this is decidedly reflexed, and in the other the whole shell is strongly tinged with red. They measure $25\frac{1}{4}$ and $26\frac{1}{2}$ mm. in diameter. There is no evidence of any tendency to bands, nor to the development of a parietal tooth so characteristic of *altivaga*, in any of these specimens.

This form extends as far north as Roan mountain. Four specimens from Roan mountain R. R. Station are as heavy as an ordinary *P. albolabris*, with a broad, thick, flattened or convex lip, and of a decided yellow-horn color. They measure $27\frac{1}{4}$ x 23, $27\frac{1}{4}$ x 22, 26 x $19\frac{3}{4}$, $27\frac{1}{2}$ x 21 mm., and approach var. *altivaga* very closely.

Polygyra thyroides (Say).

Paint Rock, north side; Tyson's and Wilson's Coves. Scarce.

Polygyra clausa (Say).

Two specimens only at Paint Rock, on the south side of the river.

Polygyra wheatleyi (Bland).

This species was found nearly everywhere and usually in abundance. There is no apparent tendency to develop a smaller race on the higher portions of Mitchell as on the peaks of the Smoky mountains, although three-fourths of the specimens from Mitchell and Cat-tail were edentate, while those from Bluff mountain were all dentate and with the outer margin of the lip dark colored. These varied from $13\frac{3}{4}$ to 16 mm. in diameter, while those from Mitchell and Cat-tail averaged larger, running from $14\frac{1}{4}$ to 16. Ferriss found it also at Paint Rock, Tyson's, Wilson's, Meadow Cove, Great Craggy, Bee Tree Cove and Toe river.

Polygyra stenotrema (Fer.).

Common on both sides of the river at Paint Rock. One only from Wilson's Cove. All these have a rather wide lip notch, otherwise typical.

Polygyra altispira Pilsbry.

"*Stenotrema hirsutum* Say. An elevated, somewhat carinated variety," Wetherby, Some Notes on American Land Shells, No. II, p. 7, No. 33, in Jour. Cincinnati Soc. N. H., IV, 1881, p. 329. Natural History notes from N. C., No. 2, in Jour. Cin. Soc., 1894, p. 212.

Polygyra hirsuta altispira Pilsbry, Nautilus, VII, p. 141 (April, 1894).

This species was first noticed in 1881, by Mr. A. G. Wetherby, as a variety of the widespread *P. hirsuta* Say. Compared with

P. hirsuta it differs in the following respects: *P. altispira* is more elevated, the spire being conical, with an additional whorl; the notch in the basal lip is wider, with a well-developed tooth on each side in place of an even edge, and the "fulcrum" is much smaller. These differences are constant in a large series of each examined and, in the absence of intermediate forms, warrant us in giving *altispira* specific rank. *P. altispira* is usually larger than the other species. It is densely hirsute or bristly above and below, the bristles erect and standing about as close as in *P. hirsuta*.

P. depilata of the Great Smoky range differs from *P. altispira* chiefly in the shallower notch of the basal lip and the totally diverse character of the surface.

Mt. Mitchell, mostly large, $6\frac{1}{2}$ x 9 to 9 x 11 mm., spire lower than in Roan mountain types. Many of the lots are larger shells than at Roan mountain, with the spire less raised.

P. altispira seems to range along the eastern slope of the mountains as far south at least as Swain and Jackson counties, where a small form occurs at Balsam mountain and elsewhere. The region lying between Asheville and these counties is wholly unknown conchologically. Balsam mountain, $5\frac{1}{2}$ whorls, diam. fully 8 mm. Smallest from Jackson county, $5\frac{1}{2}$ whorls, diam. 7 mm. As small as *hirsuta*, but have the wide notch, small fulcrum and rather harsh or stiff pile of *altispira*. The character of the bristles separates this small form from *magnifumosa*.

P. altispira was not found at Paint Rock, where it is apparently replaced by *P. pilula*; but nearly everywhere else it was found in considerable abundance. The localities comprise Bluff mountain, Mitchell, Cat-tail, Wilson's, Meadow Cove, Tyson's, Ivy river and Bee Tree Cove.

Polygyra pilula Pilsbry.

Polygyra hirsuta pilula Pilsbry, Proc. A. N. S. Phila., 1900, p. 132.

Paint Rock, on both sides of the river. This species was originally described as a variety of *Polygyra hirsuta*. Its occurrence at Paint Rock was quite unexpected, and gives it a much more extended range than was anticipated when first noticed. This fact and the evident stability of its peculiar characteristics, as shown by the specimens before us, without any apparent tendency to merge into the typical *hirsuta*, justify us in according to it specific rank.

Polygyra monodon cincta (Lewis).

Paint Rock, south side, one specimen, with the umbilicus somewhat smaller than in the types.

Bluff mountain, two specimens, with umbilicus almost closed. The occurrence of this species in the French Broad valley, far north of any previous records, was one of the surprises furnished by the collection of 1901.

PUPIDÆ.**Strobilops labyrinthica strebeli** (Pfr.).

Helix strebeli Pfr., Malak. Blätt., VIII, 71, t. l., figs. 5-8 (1861).

Paint Rock, south side, a single specimen only. This is much farther north than previously recorded and, like the preceding species, is a striking example of the mingling in the French Broad valley of the southern species with those coming from the north

ACHATINIDÆ.**Cochlicopa lubrica** (Müll.).

Potato Top, where Ferriss found typical examples, is the only locality represented in the present collection. Walker found it, however, several years previously on Town mountain near Asheville.

CIRCINARIIDÆ.**Circinaria concava** (Say).

Paint Rock, on both sides of the river; Bluff mountain, Wilson's, Tyson's, Cat-tail and Ivy river.

Common everywhere and of good size, ranging from $17\frac{1}{4}$ to $21\frac{3}{4}$ mm. in diameter.

ZONITIDÆ.**Omphalina fuliginosa** (Griff.).

Typical specimens were found on both sides of the river at Paint Rock.

Omphalina laevigata (Raf. Beck).

One mature specimen, $19 \times 13\frac{1}{2}$ mm., and several immature ones were taken on the north side of the river at Paint Rock.

Omphalina subplana (Binney).

This was one of the most abundant species, both at Bluff mountain and Mt. Mitchell. Very large fine specimens were found on

the south side of the river at Paint Rock, frequently reaching 22 and 23 mm. in diameter. Both here and at Bluff mountain a peculiar form was found with more convex base, not excavated around the umbilicus, and approaching *O. rugeli* W. G. B. Many of the specimens from these localities were quite green. Found also at Tyson's, Potato Top, Ivy river, Toe river, Wilson's and Cat-tail.

***Omphalina andrewsæ* Pilsbry.**

Very rare, apparently at about the extreme of its northern range, but quite typical. Mt. Mitchell, 2; Wilson's, 1; Potato Top, 2, and Tyson's, 1.

***Vitrinizonites latissimus* (Lewis).**

This species, which was not uncommon on Mt. Mitchell, was found only sparingly at other localities. Those from Bluff mountain were considerably larger than those from Mitchell, reaching $19\frac{1}{4}$ mm. in diameter. It occurred also at Paint Rock, south side; Tyson's, Wilson's, Meadow Cove and Bee Tree creek.

***Vitre a carolinensis* (Ckll.).**

Vitre a carolinensis Ckll., *Nautilus*, XIII, p. 120.
Zonites carolinensis Ckll., *Binney, Bull. M. C. Z.*, XXII, p. 167, Pl. III, fig. 7.

The type specimens as described by Cockerell have 5 whorls with a maximum diameter of 10 mm. This form occurred in 1901 only at Paint Rock. It is not found in the Great Smoky mountains, and from present information it seems to be a rare form of very limited distribution.

***Vitre a carolinensis wetherbyi* Ckll.**

Nautilus, XIV, p. 45 (1901).

Paint Rock, Bluff mountain, Tyson's, Wilson's, Mt. Mitchell, Cat-tail, Pinnacle of the Blue ridge, Toe river and Potato Top.

In the report of the expedition of 1899 the specimens of *V. carolinensis* were found to belong to a small race, ranging from $5\frac{1}{2}$ to 7 mm. in diameter. Cockerell has since distinguished it under the above varietal name. With the exception of some from Paint Rock, all the specimens collected in 1901 belong to this smaller variety, which, though not found anywhere in abundance, occurred in nearly every locality. It is intermediate between typical *V. carolinensis* and *V. indentata*.

Vitrea sculptilis (Bld.).

A single specimen, diameter $8\frac{1}{2}$ mm., was taken on Bluff mountain.

Vitrea hammonis (Ström.). Pl. XXIII, figs. 10, 11, 12.

Paint Rock, south side, one specimen. The shell figured for comparison with the following species is from Mohawk, N. Y.

Vitrea clingmani Dall. Pl. XXIII, figs. 1, 2, 3.

Zonites wheatleyi W. G. Binney, Man. Am. Land Shells, 223.

Vitrea wheatleyi clingmani Dall, Nautilus, XI, 100 (1890).

Vitrea clingmani Dall, Proc. A. N. S. P., 1900, p. 150, fig.

As stated in Dall's description cited above, the types of this rare species were taken by Hemphill at or near Clingman's Peak, or Mt. Gibbs according to the map of the Topographical Survey. The first specimens in 1901 were found on Mt. Clingman, beside the trail just north of the summit. Four specimens were found under one log a short distance below the summit of Mt. Mitchell on the northeast side. It is evidently rare on Mitchell, as most careful search failed to bring any more to light. A single specimen was taken on Wilson's Cove and another on Cat-tail.

Ferriss found it in some greater quantity on Potato Top, but it appears to be rare even there.

V. clingmani is peculiar to Black mountain range. It is one of the largest of the Vitreas and, once seen, is easily recognized. The animal is dark bluish-black, and when alive the whole shell appears black; in this respect it reminds one of *Zonitoides nitidus* Müll. When cleaned the shell varies from a yellow to reddish horn-color, but occasional specimens are tinged with green as stated in Dr. Dall's description.

Vitrea approxima W. and P., n. sp. Pl. XXIII, figs. 7, 8, 9.

Shell about the size and shape of *V. hammonis*; glossy, smoky greenish horn-color, tinged with pink above; umbilicus round and deep; slightly convex above, whorls $4\frac{1}{2}$, regularly increasing, surface sculptured above with irregularly spaced radial grooves similar to those of *V. hammonis*, but less crowded and with microscopic revolving impressed lines; aperture transversely rounded-lunate. Alt. 2, greater diam. $4\frac{1}{2}$ mm.

Two specimens only of this species, which cannot be satisfactorily assimilated with any of the described species, were taken in Wilson's Cove, Mt. Mitchell. It is closely related to *V. hammonis* in

shape, and in the regularly increasing whorls, but differs in color, in the less crowded sculpture of radial grooves, the presence of microscopic revolving sculpture, which is absent in *hammonis*, and in having nearly a whorl additional. In the examination of these forms for the revolving sculpture a compound lens of at least 100 diameters is necessary for satisfactory results. *V. wheatleyi* and *V. petrophila pentadelphia*, which have similar sculpture, differ in having a more open umbilicus and in the rapid enlargement of the last whorl. It differs from *V. rhoadsi* by the smooth base (*V. rhoadsi* being radially grooved beneath), the closer radial grooves, wider umbilicus, and in color.

***Vitrea vanattai* P. and W., n. sp. Pl. XXIII, figs. 4, 5, 6.**

Shell rather narrowly umbilicate (the umbilicus about one-sixth the diameter of the shell), depressed, thin, honey-yellow and translucent. Sculpture of many deeply impressed, irregularly spaced radial grooves, much less conspicuous beneath, and very fine, rather faint, close spiral lines. Whorls 5, slowly increasing, the last much wider. Aperture oblique, broadly lunate, the peristome simple and thin as usual. Alt. hardly 2, diam. 4.5 mm.

Mt. Mitchell, two adult specimens and one young.

This species belongs to the same group as the preceding, from which it differs in color, the more depressed body-whorl, less crowded and deeper radial grooves, which are more distinct beneath, in having a half-whorl more and a wider umbilicus. In *V. hammonis* the sculpture is much closer, the grooves of *V. vanattai* resembling those of the species of the section *Glyphyalinia*. It resembles *V. clingmani*, but with the same number of whorls the shell is much smaller, and the shape of the aperture differs somewhat.

It is named for Mr. Edward G. Vanatta, in recognition of his long and careful work upon the smaller Zonitidae of the collection of the Academy.

The group of *V. hammonis*, *clingmani*, *approxima* and *vanattai* consists of species similar in general form and in the coarser sculpture. *V. hammonis* differs from all the others by the smaller number of whorls and less depressed contour; *V. clingmani*, with the same number of whorls as the following species, is conspicuously larger. *V. approxima* and *V. vanattai* have about the same number of whorls, but the former is greenish, less deeply sculptured,

and with a narrower umbilicus than *V. vanattai*, which is yellow and less fragile.

V. clingmani was drawn on a smaller scale than the other species on the plate.

Zonitoides arboreus (Say).

Paint Rock, on both sides of the river, Bluff mountain; Mitchell, Cat-tail, Wilson's, Tyson's, Potato Top and Ivy river. In Tyson's Cove this species was found in great abundance. It was also common on Potato Top. Elsewhere it seemed to be comparatively rare.

In addition to the more obvious differences between this species and *Vitrea hammonis*, *Z. arboreus* under a glass of high power will be found to have the surface covered with numerous very fine, impressed revolving lines which are lacking in *hammonis*.

Zonitoides elliotii (Redfield).

Common at Paint Rock, on both sides of the river, and at Tyson's. A few were also taken on Bluff mountain and a single specimen in Wilson's Cove, Mt. Mitchell.

Gastropoda intertexta (Binn.).

Not taken in 1901. It occurs, however, at Asheville, where it was found by Walker on a previous visit.

Gastropoda acerra (Lewis).

Paint Rock, Mt. Mitchell, Cat-tail, Tyson's, Potato Top, Meadow Cove, Ivy river and Toe river.

Apparently not as abundant in this region as it is either at Roan or in the Smoky mountains. It was more numerous in the Mt. Mitchell region than around Paint Rock and Bluff mountain. As usual in any considerable suite of specimens, there is considerable variation in the height of the spire. Those from Cat-tail were unusually fine, the largest examples of the two forms measuring $17\frac{1}{2} \times 14$ and $16\frac{3}{4} \times 11\frac{1}{2}$ mm.

Gastropoda demissa (Binn.).

Not taken in 1901. It has been found on Town mountain, near Asheville, by Walker.

Gastropoda suppressa (Say).

This species did not occur in the collection of 1901. It has, however, been found at Asheville, on Town mountain (coll. Walker). It was also found at Spencer's Cabin on Thunderhead in 1899, but was overlooked at the time of making the report.

Gastropoda gularis (Say).

At Paint Rock, on the north side of the river, a form of this species was taken which is like the depressed examples from Hayesville, N. C., mentioned in the report of the Pentadelphian expedition. Aside from this lot, no specimens were taken agreeing with the form of *gularis* almost everywhere prevailing in the Great Smoky mountains.¹⁵ In its place, three well-marked subspecies of *gularis* occurred.

Gastropoda gularis theloides A. D. Brown, n. subsp. Pl. XXV, figs. 1, 2, 3, 4.

Shell glossy, yellow, perforate, with moderately raised, dome-shaped spire, composed of $7\frac{1}{2}$ to 8 narrow, closely coiled whorls; the last hardly regular at the periphery in adult shells; rather strongly striate above, nearly smooth beneath, with faint traces of spiral striae near the umbilicus, where the base is rather conspicuously excavated. *Aperture somewhat triangular, the sloping basal lip being straight.* The peristome is acute, strengthened within by a rather wide, low callous rim. *Adult shells are without teeth or laminae.* Alt. 4 $\frac{1}{2}$ -5, diam. $7\frac{1}{2}$ -8 mm.

Young shells (5 to 6 mm. diam., Pl. XXV, fig. 4) are nearly discoidal, with the umbilicus as wide as in adults, base glossy, sculptured like the adult shells, the aperture armed within with two long strong lamellæ, the summit of the outer one curving toward the inner; there is also, in early stages, a smaller lamella peripheral in position.

“North Carolina” (A. D. Brown coll., No. 56,914 A. N. S.); Black mountains, N. C. (Henry Hemphill); abundant on Bluff mountain; a few only at Meadow Cove, Wilson’s and Mt. Mitchell.

Fig. 3 is from one of A. D. Brown’s specimens; figs. 1, 2, 4 are from Bluff mountain shells, collected by Walker.

This race was recognized by A. D. Brown many years ago and named in his collection (now in coll. A. N. S. P.), but it seems never to have been characterized by him. Various correspondents in America and England have submitted similar shells to one of us, and had them so named; owing to the desire to avoid overloading the nomenclature of a difficult group, the name has not hitherto been published.

¹⁵ *Vide* these *Proceedings* for 1900, pp. 142, 143.

The specimens now brought to light demonstrate the necessity of recognizing the race. It differs from *G. g. lawæ* (W. G. B.) in the much narrower umbilicus; from *G. gularis* of the Great Smoky mountains in being toothless in the adult stage, and with a more excavated base and straighter basal lip. No adult shell, in a large number examined, possessed internal laminæ.

Gastrodonta gularis lawæ (W. G. B.). Pl. XXV, figs. 10, 11, 12.

Zonites placentulus (Shuttle.), W. G. Binney, Terr. Moll. U. S., V., p. 124, fig. 44, Pl. III, f. L. (dentition) and remarks, but not the description (1878).

Zonites lasmodon var.? W. G. Binney, Ann. N. Y. Acad. Sci., I, pp. 358-362, Pl. 15, f. e. (1879).

Zonites lawi W. G. Binney, 1st Supplement to Terr. Moll., V., p. 142, Pl. 2 (reprint of Pl. 15, Ann. N. Y. Acad. Sci., I), fig. e (1883). Manual of Amer. Land Shells, p. 221, fig. 235.

The shell is yellow, glossy, with moderately elevated, dome-like spire, composed of 8 closely coiled whorls; surface rather closely wrinkle-striate, the striæ strongest near the suture, weaker below, where a few faint spiral striæ may be traced. Last whorl rounded, hardly angular, even in front. *Umbilicus wide, open, deep and well-like*, the bases of the first whorls visible in its depth. Aperture small, irregularly lunate; peristome acute, strengthened within by a rather thin, diffused white callus, which becomes heavier within the columellar margin, making a slight convexity or low boss near the axis. Columellar margin somewhat straightened. Alt. 4.7, diam. 7.8 mm., width of umbilicus 1.3 mm.

The above description and figures 10-12 represent the type shell, which differs from most other specimens in being without internal lamellæ. Binney (*Supplement*, p. 143) mentions that "there is a variety in which is a heavy internal callous or plate-like teeth within the aperture," and this (Pl. XXV, figs. 14, 15, 16, 17) is certainly the prevalent form in the localities collected at in 1901. These dentate specimens have the long, strong, arching basal lamella of *G. gularis cuspidata*. Whether the lamina-bearing form will eventually be separated from the toothless typical form remains for future investigation, the material now available being insufficient for a decision.

This race has not hitherto been defined, although Binney has figured it in three publications. The figures, however, were not good, and on account of its association with the very different *G. placentula* (Shuttle.), it has not been generally recognized by

students of our land snails. The toothless form occurs in Monroe county, Tenn., where it was collected by Miss Annie Law, together with specimens provided with internal laminæ. These were distributed to Mr. Binney, Dr. James Lewis, and probably others. The Lewis collection was sold, and there are specimens from this source in the collections of George H. Clapp, G. K. Gude, the Academy of Natural Sciences, and perhaps others. The toothless specimen illustrated in figs. 10-12 is No. 294 of the Binney and Bland collection, American Museum of Natural History, kindly lent by Mr. L. P. Gratacap. It is the individual figured by Binney, referred to at the head of this account.

The form was given specific rank by Mr. Binney, but in our opinion it is merely a subspecies of the variable *G. gularis*, distinguished by the wider umbilicus, and the absence of teeth in some adult specimens. *G. gularis theloides* differs from *lawæ* by its very small umbilicus. In *G. lasmodon* the umbilicus is still wider. The size of the umbilicus varies a good deal in the North Carolina specimens. Thus in specimens from Paint Rock, measuring 8 mm. diam., the umbilicus is from 1 to 1.7 mm. wide.

The young shells are always toothed (Pl. XXV, figs. 14, 15), there being a long outer lamella, a shorter baso-columellar, and in early stages a small supra-peripheral plait. The umbilicus is broad and the periphery situated high on the last whorl. The shell figured measures 5 mm. diam.

It is quite common on both sides of the river at Paint Rock. Two only on Bluff mountain.

Gastropoda gularis decussata Pilsbry and Vanatta, n. subsp. Pl. XXV, figs. 5, 6, 7, 8, 9, 13.

Shell somewhat dull, brownish, *narrowly umbilicate*, with moderate or high, dome-shaped spire, composed of 8 flat whorls, *the last angular at the periphery*. Closely, sharply and strongly striate above, less so beneath, where there are usually *traces of spiral striae* near the periphery. Aperture lunate, peristome thin and acute, armed within with a blunt tooth on the middle of the columella, and a *high, short, erect lamella* within the outer-basal margin. Alt. 5.5, diam. 7.8 mm. Alt. 5, diam. 8.2 mm.

Young shells (Pl. XXV, figs. 8, 13, diam. 6 mm.) are biconvex, depressed, acutely angular or carinate, more strongly striate beneath than adults, and with the striae on the outer half of the

base *decussated by many impressed spirals* (fig. 8). The internal lamellæ are long, as in the young of other forms of the *gularis* group.

Most abundant on Mt. Mitchell, the type locality. Found also at Tyson's, Wilson's, Potato Top, Cat-tail, Ivy river, Bee Tree Cove and Bluff mountain.

This variety was first recognized several years ago by Mr. Vanatta and one of the present writers, among specimens collected by Mr. Hemphill, labeled "Black Mts., N. C." The specimens were found with *G. gularis theloides*. On account of the small number of specimens (two adult and one young), it was not defined at that time. The abundant material taken in 1901 places the subspecies upon a secure basis. It differs from *G. gularis* and the racial forms subordinated to that species in the strong sculpture, comparatively dull surface, the decussation and acute carination of the young shells, and the short, high, erect lamella of the adult stage. Compared with *G. collisella* Pils., the var. *decussata* is seen to differ in the closer and flat whorls of the spire, flattened instead of swollen base, carinate periphery, etc. Young shells resemble *G. intertexta* in sculpture.

***Gastrodonta interna* (Say).**

Common on both sides of the river at Paint Rock and at Tyson's. A few were also taken on Potato Top, Cat-tail and in Bee Tree Cove.

***Gastrodonta andrewsæ* (W. G. Binney).**

Very abundant on Potato Top and not uncommon on Mt. Mitchell and Bluff mountain. A few were also taken on Cat-tail and at Bee Tree Cove, Toe river and at Paint Rock, on the south side of the river. One specimen from this last locality has the teeth fused together, forming a continuous rib across the cavity of the shell as in *G. lamellidens*.

***Gastrodonta lamellidens* Pilsbry.**

A single specimen was taken on Bluff mountain, and another on the Toe river side of the Pinnacle of the Blue ridge.

PHILOMYCIDÆ.

***Philomycus carolinensis* (Bosc.).**

Not so abundant as in the Great Smoky mountains. A few only were seen on Bluff mountain and Mt. Mitchell.

Philomyces hemphilli (W. G. Binney).

Common on Mt. Mitchell, which is the type locality.

ENDODONTIDÆ.**Pyramidula alternata** (Say).

The typical form occurred only at Paint Rock, on both sides of the river. Those from the north side have the ribs much heavier and farther apart than those from the south side.

At Tyson's, Wilson's and Ivy river were found smoother, brighter forms, approaching *fergusoni* Bld. somewhat, especially in the gloss, but with the ribs more prominent. The spiral sculpture is well developed, the spiral lines being unusually prominent. This micro-sculpture, however, is practically the same in *mordax*. Periphery rounded. This is a race of the region, unlike the Great Smoky forms and the antithesis of *mordax*. This form, according to Wetherby¹⁶ (who refers it to var. *fergusoni*), is the only form of *alternata* found at Roan mountain. Roan specimens, however, though more lightly ribbed than those from Mitchell, are nearer to them than to the typical *fergusoni*. The same form also occurs at Elizabethton, Tenn., and Scott county, Va. In the latter locality it is said to be "found only on trees high up on the mountains" (G. H. Clapp). This tree-climbing habit is also noticed by Wetherby, but was not observed by any of the party in 1901.

Pyramidula alternata mordax (Shuttleworth).

In 1852, Shuttleworth¹⁷ described his *Helix mordax* from specimens collected by Rugel in the mountains of North Carolina. The original description was reprinted by W. G. Binney in *Terr. Moll.*, III, p. 19, but by a clerical error the dimensions of *Zonites placenta*, which was described at the same time, were included in the description of *mordax*. Shuttleworth's description may be translated as follows:

"Shell widely and perspectively umbilicated, depressed, sub-lenticular, carinate, thin, yellow horn-color, ornamented with interrupted red streaks in bands, beautifully sculptured with strong flexuose ribs above and below; whorls $5\frac{1}{2}$, flat; aperture very oblique, angularly crescentic, oval; peristome simple, acute. Greater diam. 18, lesser 16, height 6 mm.

¹⁶ *Jour. Cincinnati Soc. N. H.*, 1894, p. 75.

¹⁷ *Bern. Mittheil.*, 1852, 195.

"Hab. in the mountains of North Carolina; more than 12 specimens taken by Rugel.

"Obs. very close to *H. alternata*, but distinguished by the stronger ribs which are 1 mm. apart. *H. cumberlandiana* Lea (perhaps a wholly abnormal form) in which the carina is similar, differs (according to the figure) in having the shell only lightly striate, not costate."



Many attempts to identify this form have been made by Binney and others, but, as stated by one of us,¹⁸ the shells usually labeled *mordax* are referable to another strongly ribbed form of *alternata*, and do not fulfill the requirements of Shuttleworth's diagnosis given above.

As this was the only species of land snail belonging to the Eastern fauna that had not been satisfactorily determined, the discovery by Mr. Ferriss of specimens agreeing almost exactly with the original description of *mordax* is a matter of great interest. These specimens were found in Tyson's Cove (alt. 4,000 feet), which lies between the Great Craggy mountains and the Pinnacle of the Blue Ridge and at the southern extremity of the Black mountain chain, and in Bee Tree Cove (alt. 3,500 feet), which lies just west of the Great Craggy mountains. As both Tyson's and Patton's Knob were well-known resorts long before the Civil War, it is quite likely that this is the original locality. Of course this is a mere supposition, but the fact that the form has never been found elsewhere, and that in Shuttleworth's time the locality was one of the few accessible to the ordinary traveler, would seem to render it quite probable.

There would seem to be no question but these shells are the long-lost *mordax*. They agree exactly with Shuttleworth's description in having heavy ribs, fully a millimeter apart at the periphery, and which extend on the under side into the umbilicus. The carina is

¹⁸ *Nautilus*, XV, p. 7.

well developed, though rather more rounded than in var. *carinata* Pils., but the under side just below the carina is distinctly concave, as in *Pyramidula bryanti*. This disappears somewhat in full-grown specimens toward the aperture, but is always evident on the first two-thirds of the last whorl, and is particularly marked in the young shells. The micro-sculpture is well developed, consisting of very fine irregular lines of growth between the ribs, which are cut transversely by numerous fine revolving lines. The only difference observable in these shells is that of size. Of our specimens none equals the dimensions given by Shuttleworth. Our largest example has a greater diameter of $17\frac{1}{2}$, lesser 15, with an altitude from the base of $6\frac{1}{2}$ mm. If Shuttleworth's types measured only 6 mm. from the basal lip, they are more lenticular than any form of *alternata* yet known, and the true *mordax* yet remains to be discovered. It is probable, however, that Shuttleworth followed Pfeiffer in measuring the height from the base of the axis.

The form here figured as *P. a. mordax* seems to be confined to a particular zone on the mountainside, and does not appear to mix with the smooth form of *alternata*. "It has the same habits as the common form, around old basswood and tulip tree logs, but the two were never together. *Mordax* dwelt in the tulip-tree belt, and the common form was both above and below, but never in that belt" (J. H. F.).

***Pyramidula perspectiva* (Say).**

Paint Rock, on both sides of the river, fairly abundant; scarce in Wilson's Cove, and a single specimen only from Cat-tail.

***Pyramidula bryanti* (Harper).**

The original description of Harper¹⁹ is not as full in detail as could be desired. Wetherby's observations²⁰ are far more exact and give a better idea of the specific characters. As he states, "the whorls are heavily ribbed above and below, the rib terminating at a sharp angle on the upper and under outer edges of the body whorl, leaving a concave space between, which is comparatively smooth." In occasional specimens, however, toward the aperture the ribs, in a less developed form, are carried across from one carina to the other. The types came from Mitchell county, N. C., and probably from Roan mountain. At any rate, Roan mountain specimens are quite typical in every respect. Typical

¹⁹ *Jour. Cincinnati Soc. N. H.*, 1881, p. 258.

²⁰ *Jour. Cincinnati Soc. N. H.*, 1881, p. 328. Reprint, p. 7.

examples were found not uncommon at Paint Rock, on the south side of the river, and specimens nearly so, differing, however, in the less acute development of the lower carina, occurred in Wilson's and Tyson's Coves.

On Cat-tail and Potato Top and in Bee Tree Cove, the specimens have both the keels less acute, and are more striate below the periphery. This form is intermediate between the typical *bryanti* and the Mt. Mitchell form which has the characteristics of a well-marked subspecies, the base being regularly costulate, the keels blunt and the intercarinal concavity nearly obsolete, much as in *perspectiva*. Young shells, however, are less specialized and resemble the intermediate form mentioned above. But the internal columellar tubercle, exceedingly constant in *perspectiva*, is wholly wanting. It is a peripheral form, probably at the geographic confines of the range of *bryanti*.

SUCCINEIDÆ.

Succinea ovalis Say.

A single young specimen was taken at Paint Rock, on the south side of the river, and two examples of the thin mountain form were found in the gap between Mt. Mitchell and Clingman's Peak.

The form here referred to is that commonly known as *S. obliqua* Say. Say described *Succinea ovalis*²¹ in 1817 and *S. obliqua* in 1824.²² Gould in 1841²³ referred the form commonly known as *ovalis* to Say's *ovalis* of 1817. Say's types of *ovalis* are in the collection of the Academy and belong to the form usually known as *obliqua*. This being so, *ovalis* has priority and must consequently be used, *obliqua* falling into the synonymy. The use of *obliqua* for Say's species was inaugurated arbitrarily by Dr. Amos Binney²⁴ in an "attempt to reconcile the differences" in the use of the names by retaining *ovalis* for Gould's species and applying to "Mr. Say's species his second name *obliqua*." This, of course, he had no right to do.

AMNICOLIDÆ.

Pomatiopsis lapidaria (Say).

A pale-green form of this species, rather more slender than the common northern form, was taken at Paint Rock, on the south side of the river.

²¹ *J. A. N. S. P.*, I, 15 (1817).

²² *Long's Exped.*, II, 260 (1824).

²³ *Invert. Mass.*, 194.

²⁴ *Terr. Moll.*, II, 64.

PLEUROCERIDÆ.

Goniobasis proxima symmetrica (Hald.).

Paint Rock creek, N. C. This was the only species of fluvialtine mollusk found during the trip.

No indications whatever of Unionidæ or Pleuroceridæ were found in the French Broad at Paint Rock.

EXPLANATION OF PLATES XXIV AND XXV.

[ERRATA.—References to "Plate XXIII" on pages 431 and 432 should read *Plate XXIV*.]

PLATE XXIV, Figs. 1, 2, 3.—*Vitreæ clingmani* Dall. Potato Top, Black Mts., N. C. No. 83,262 A. N. S. P.

Figs. 4, 5, 6.—*Vitreæ vanattai* P. and W. Mt. Mitchell, N. C. No. 83,261 A. N. S. P.

Figs. 7, 8, 9.—*Vitreæ approxima* W. and P. Mt. Mitchell, N. C. No. 83,260 A. N. S. P.

Figs. 10, 11, 12.—*Vitreæ hammonis* (Strom). Mohawk, N. Y. No. 53 A. N. S. P.

PLATE XXV, Figs. 1, 2.—*Gastrodonta gularis theloides* (A. D. B.). Bluff Mt., N. C. No. 83,263 A. N. S. P.

Fig. 3.—*G. g. theloides*. Aperture of a specimen from A. D. Brown's collection. No. 56,914 A. N. S. P.

Fig. 4.—*G. g. theloides*. Basal view of a young shell from Bluff Mt., N. C. No. 83,263 A. N. S. P.

Figs. 5, 6, 7.—*G. g. decussata* P. and V. Three views of the type, Mt. Mitchell, N. C. No. 83,265 A. N. S. P.

Fig. 8.—*G. g. decussata*. Much enlarged view of a segment of the base of a young specimen from Bluff Mt., N. C. No. 83,264 A. N. S. P.

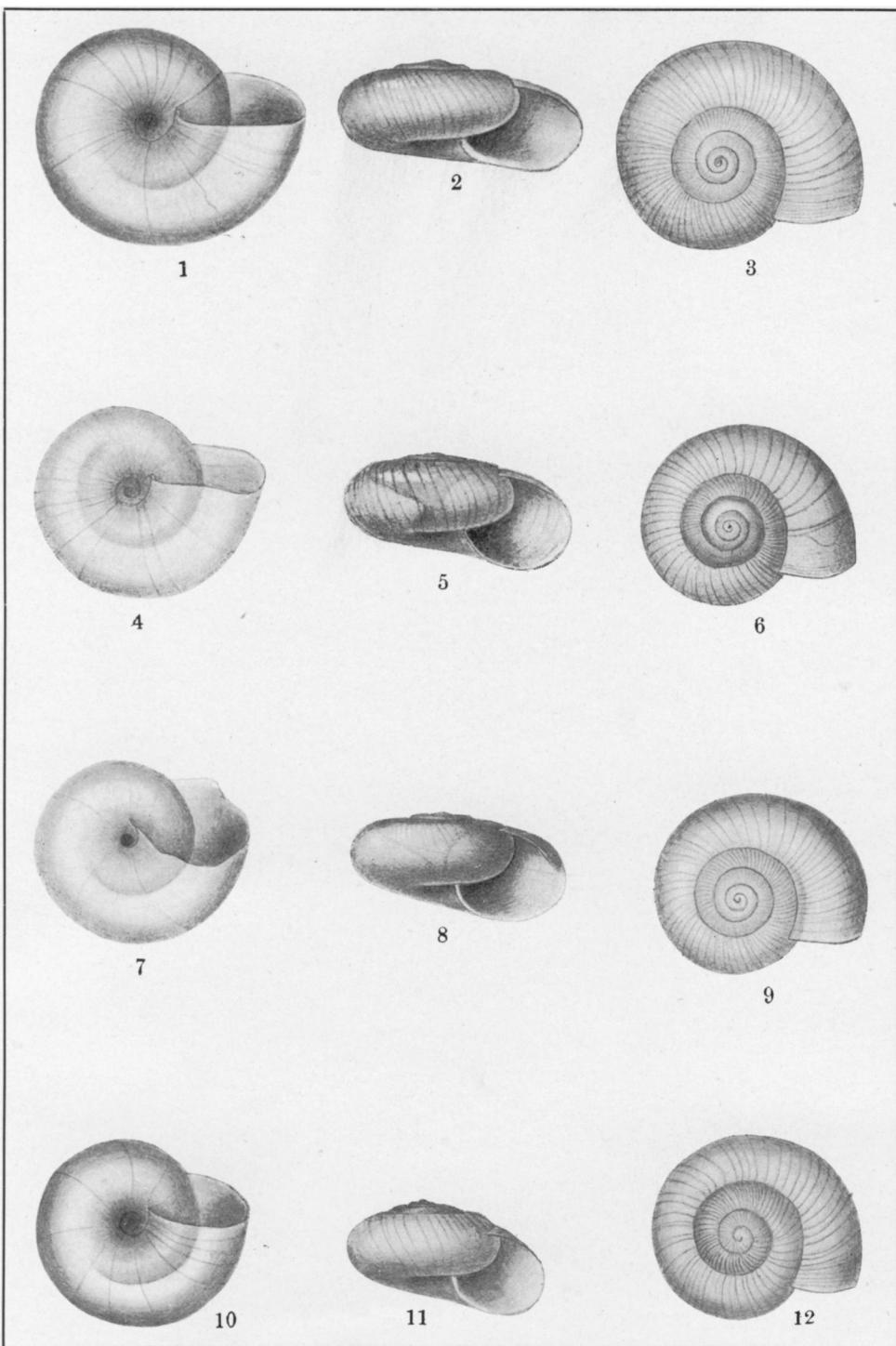
Fig. 9.—*G. g. decussata*. Another specimen from the type lot, Mt. Mitchell. No. 83,265 A. N. S. P.

Figs. 10, 11, 12.—*G. g. lavae* (W. G. B.). Three views of the type specimen. Diam. 8 mm. No. 294 of the "Binney and Bland Collection," American Museum of Natural History, N. Y.

Fig. 13.—*G. g. decussata*. Young shell from Bluff Mt., N. C. Same specimen shown in fig. 8.

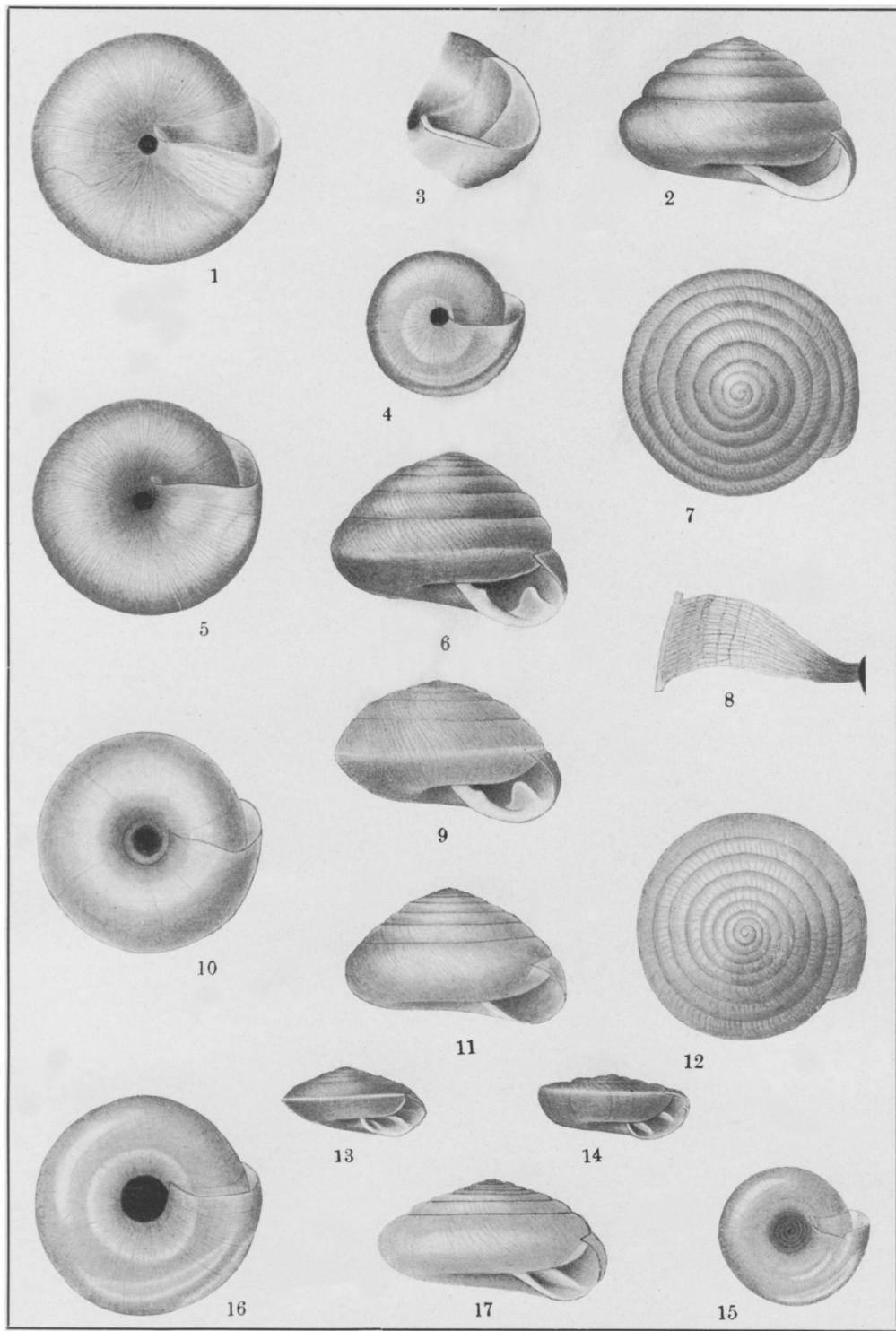
Figs. 14, 15.—*G. g. lavae*. Young shell from North side of the French Broad river at Paint Rock, N. C. No. 83,266 A. N. S. P.

Figs. 16, 17.—*G. g. lavae*. Adult shell of the laminate form. North side French Broad river, Paint Rock, N. C. No. 83,266 A. N. S. P.



E. G. Vannatta, del.

WALKER AND PILSBRY. MT. MITCHELL MOLLUSCA.



E. C. Vanatta, del.

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